

Nonlinear Absorption-Gain Response and Population Dynamics in a Laser-Driven Four-Level Dense Atomic System

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(Received: 2005-9-22; Revised:)

Abstract: We theoretically investigate the response of nonlinear absorption and population dynamics in optically dense media of four-level atoms driven by a single-mode probe laser, via taking the density-dependent near dipole-dipole (NDD) interactions into consideration. The influence of the NDD effects on the absorption of the probe field and population dynamics is predicted via numerical calculations. It is shown that the NDD effects can reduce gradually to transient absorption with the increase of the strengths of the NDD interactions, and transient amplification can be achieved. In the steady-state limit, the probe field exhibits transparency for strong NDD interactions. Alternatively, the population entirely remains at the ground state due to the NDD effects.

PACS: 42.50.Gy, 42.50.Md, 42.65.An

Key words: absorption spectra, population dynamics, near dipole-dipole interactions

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